

REFERENCE: B-5731

PROJECT: 45687

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	B-5731	1	17

**STATE OF NORTH CAROLINA**  
**DEPARTMENT OF TRANSPORTATION**  
**DIVISION OF HIGHWAYS**  
**GEOTECHNICAL ENGINEERING UNIT**

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**STRUCTURE**  
**SUBSURFACE INVESTIGATION**

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COUNTY GUILFORD

PROJECT DESCRIPTION BRIDGE NO. 112 ON SR 2109  
(EVERSFIELD RD.) OVER HAW RIVER

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2, 2A, 2B, 2C	LEGEND
3	BORING LOCATION PLAN
4-13	BORING LOGS, CORE LOGS AND CORE PHOTOGRAPHS
14	SITE PHOTOGRAPHS

PERSONNEL

TRIGON

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DRAWN BY HILL, M.J.

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SUBMITTED BY FALCON ENG.

DATE JULY 2017

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DocuSigned by:

Jeremy R Hamm

7/27/2017

SIGNATURE  
ED7938089E22487

DATE

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**NORTH CAROLINA DEPARTMENT OF TRANSPORTATION  
DIVISION OF HIGHWAYS  
GEOTECHNICAL ENGINEERING UNIT**

# SUBSURFACE INVESTIGATION

## SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS (PAGE 1 OF 2)

**SOIL DESCRIPTION**

SOIL IS CONSIDERED UNCONSOLIDATED, SEMI-CONSOLIDATED, OR WEATHERED EARTH MATERIALS THAT CAN BE PENETRATED WITH A CONTINUOUS FLIGHT POWER AUGER AND YIELD LESS THAN 100 BLOWS PER FOOT ACCORDING TO THE STANDARD PENETRATION TEST (AASHTO T 206, ASTM D1586). SOIL CLASSIFICATION IS BASED ON THE AASHTO SYSTEM. BASIC DESCRIPTIONS GENERALLY INCLUDE THE FOLLOWING: CONSISTENCY, COLOR, TEXTURE, MOISTURE, AASHTO CLASSIFICATION, AND OTHER PERTINENT FACTORS SUCH AS MINERALOGICAL COMPOSITION, ANGULARITY, STRUCTURE, PLASTICITY, ETC. FOR EXAMPLE, VERY STIFF, GRAY, SILTY CLAY, MOIST WITH INTERBEDDED FINE SAND LAYERS, HIGHLY PLASTIC, A-7-6

**SOIL LEGEND AND AASHTO CLASSIFICATION**

GENERAL CLASS.	GRANULAR MATERIALS ( $\leq 35\%$ PASSING #200)						SILT-CLAY MATERIALS ( $> 35\%$ PASSING #200)						ORGANIC MATERIALS		
GROUP CLASS.	A-1	A-3	A-2	A-4	A-5	A-6	A-7	A-1, A-2	A-3	A-4, A-5	A-6, A-7				
SYMBOL															
% PASSING	50 MX 30 MX 15 MX	50 MX 25 MX 10 MX	51 MN 10 MX	35 MX 10 MX	35 MX 10 MX	35 MX 10 MX	35 MX 10 MX	36 MN 10 MX	36 MN 10 MX	36 MN 10 MX	36 MN 10 MX	36 MN 10 MX	GRANULAR SOILS	SILT-CLAY SOILS	MUCK, PEAT
MATERIAL PASSING #40 LL PI	— 6 MX	— NP	40 MX 10 MX	41 MN 10 MX	40 MX 11 MN	41 MN 11 MN	40 MX 10 MX	41 MN 10 MX	40 MX 11 MN	41 MN 11 MN			SOILS WITH LITTLE OR MODERATE AMOUNTS OF ORGANIC MATTER		HIGHLY ORGANIC SOILS
GROUP INDEX	0	0	0	4 MX	8 MX	12 MX	16 MX	NO MX							
USUAL TYPES OF MAJOR MATERIALS	STONE FRAGS, GRAVEL, AND SAND	FINE SAND	SILTY OR CLAYEY GRAVEL AND SAND	SILTY SOILS	CLAYEY SOILS										
GEN. RATING AS SUBGRADE	EXCELLENT TO GOOD						FAIR TO POOR						FAIR TO POOR	POOR	UNSATISFACTORY

PI OF A-7-5 SUBGROUP IS  $\leq$  LL - 30; PI OF A-7-6 SUBGROUP IS  $>$  LL - 30

**CONSISTENCY OR DENSENESS**

PRIMARY SOIL TYPE	COMPACTNESS OR CONSISTENCY	RANGE OF STANDARD PENETRATION RESISTANCE (N-VALUE)	RANGE OF UNCONFINED COMPRESSIVE STRENGTH (TONS/FT <sup>2</sup> )
GENERALLY GRANULAR MATERIAL (NON-COHESIVE)	VERY LOOSE LOOSE MEDIUM DENSE DENSE VERY DENSE	$< 4$ 4 TO 10 10 TO 30 30 TO 50 $> 50$	N/A
GENERALLY SILT-CLAY MATERIAL (COHESIVE)	VERY SOFT SOFT MEDIUM STIFF STIFF VERY STIFF HARD	$< 2$ 2 TO 4 4 TO 8 8 TO 15 15 TO 30 $> 30$	$< 0.25$ 0.25 TO 0.5 0.5 TO 1.0 1 TO 2 2 TO 4 $> 4$

**TEXTURE OR GRAIN SIZE**

U.S. STD. SIEVE SIZE OPENING (MM)	4	10	40	60	200	270
	4.76	2.00	0.42	0.25	0.075	0.053
BOULDER (BLDR.)	COBBLE (COB.)	GRAVEL (GR.)	COARSE SAND (CSE, SD.)	FINE SAND (F SD.)	SILT (SL.)	CLAY (CL.)

GRAIN SIZE	MM	305	75	2.0	0.25	0.05	0.005
	IN.	12	3				

**SOIL MOISTURE - CORRELATION OF TERMS**

SOIL MOISTURE SCALE (ATTERBERG LIMITS)	FIELD MOISTURE DESCRIPTION	GUIDE FOR FIELD MOISTURE DESCRIPTION
LL PLASTIC RANGE (PI) PL	- SATURATED - (SAT.)	USUALLY LIQUID; VERY WET, USUALLY FROM BELOW THE GROUND WATER TABLE
	- WET - (W)	SEMISOLID; REQUIRES DRYING TO ATTAIN OPTIMUM MOISTURE
OM SL	- MOIST - (M)	SOLID; AT OR NEAR OPTIMUM MOISTURE
	- DRY - (D)	REQUIRES ADDITIONAL WATER TO ATTAIN OPTIMUM MOISTURE

**PLASTICITY**

	PLASTICITY INDEX (PI)	DRY STRENGTH
NON PLASTIC	0-5	VERY LOW
SLIGHTLY PLASTIC	6-15	SLIGHT
MODERATELY PLASTIC	16-25	MEDIUM
HIGHLY PLASTIC	26 OR MORE	HIGH

**COLOR**

DESCRIPTIONS MAY INCLUDE COLOR OR COLOR COMBINATIONS (TAN, RED, YELLOW-BROWN, BLUE-GRAY). MODIFIERS SUCH AS LIGHT, DARK, STREAKED, ETC. ARE USED TO DESCRIBE APPEARANCE.

**GRADATION**

**WELL GRADED** - INDICATES A GOOD REPRESENTATION OF PARTICLE SIZES FROM FINE TO COARSE.  
**UNIFORMLY GRADED** - INDICATES THAT SOIL PARTICLES ARE ALL APPROXIMATELY THE SAME SIZE.  
**GAP-GRADED** - INDICATES A MIXTURE OF UNIFORM PARTICLE SIZES OF TWO OR MORE SIZES.

**ANGULARITY OF GRAINS**

THE ANGULARITY OR ROUNDNESS OF SOIL GRAINS IS DESIGNATED BY THE TERMS: ANGULAR, SUBANGULAR, SUBROUNDED, OR ROUNDED.

**MINERALOGICAL COMPOSITION**

MINERAL NAMES SUCH AS QUARTZ, FELDSPAR, MICA, TALC, KAOLIN, ETC. ARE USED IN DESCRIPTIONS WHEN THEY ARE CONSIDERED OF SIGNIFICANCE.

**COMPRESSIBILITY**

SLIGHTLY COMPRESSIBLE LL  $<$  31  
MODERATELY COMPRESSIBLE LL = 31 - 50  
HIGHLY COMPRESSIBLE LL  $>$  50

**PERCENTAGE OF MATERIAL**

ORGANIC MATERIAL	GRANULAR SOILS	SILT - CLAY SOILS	OTHER MATERIAL
TRACE OF ORGANIC MATTER	2 - 3%	3 - 5%	TRACE 1 - 10%
LITTLE ORGANIC MATTER	3 - 5%	5 - 12%	LITTLE 10 - 20%
MODERATELY ORGANIC	5 - 10%	12 - 20%	SOME 20 - 35%
HIGHLY ORGANIC	$>$ 10%	$>$ 20%	HIGHLY 35% AND ABOVE

**GROUND WATER**

WATER LEVEL IN BORE HOLE IMMEDIATELY AFTER DRILLING  
 STATIC WATER LEVEL AFTER 24 HOURS  
 PERCHED WATER, SATURATED ZONE, OR WATER BEARING STRATA  
 SPRING OR SEEP

**MISCELLANEOUS SYMBOLS**

	ROADWAY EMBANKMENT (RE) WITH SOIL DESCRIPTION		DIP & DIP DIRECTION OF ROCK STRUCTURES
	SOIL SYMBOL		TEST BORING
	ARTIFICIAL FILL (AF) OTHER THAN ROADWAY EMBANKMENT		AUGER BORING
	INFERRED SOIL BOUNDARY		CORE BORING
	INFERRED ROCK LINE		MONITORING WELL
	ALLUVIAL SOIL BOUNDARY		PIEZOMETER INSTALLATION
			SLOPE INDICATOR INSTALLATION
			CONE PENETROMETER TEST
			SOUNDING ROD
			TEST BORING WITH CORE
			SPT N-VALUE

**RECOMMENDATION SYMBOLS**

	UNDERCUT		UNCLASSIFIED EXCAVATION - UNSUITABLE WASTE		UNCLASSIFIED EXCAVATION - ACCEPTABLE, BUT NOT TO BE USED IN THE TOP 3 FEET OF EMBANKMENT OR BACKFILL
	SHALLOW UNDERCUT		UNCLASSIFIED EXCAVATION - ACCEPTABLE DEGRADABLE ROCK		

**ABBREVIATIONS**

AR - AUGER REFUSAL	MED. - MEDIUM	VST - VANE SHEAR TEST
BT - BORING TERMINATED	MICA - MICACEOUS	WEA. - WEATHERED
CL - CLAY	MOD. - MODERATELY	γ - UNIT WEIGHT
CPT - CONE PENETRATION TEST	NP - NON PLASTIC	γ <sub>d</sub> - DRY UNIT WEIGHT
CSE. - COARSE	ORG. - ORGANIC	
DMT - DILATOMETER TEST	PMT - PRESSUREMETER TEST	<b>SAMPLE ABBREVIATIONS</b>
DPT - DYNAMIC PENETRATION TEST	SAP. - SAPROLITIC	S - BULK
e - VOID RATIO	SD. - SAND, SANDY	SS - SPLIT SPOON
F - FINE	SL. - SILT, SILTY	ST - SHELBY TUBE
FOSS. - FOSSILIFEROUS	SLI. - SLIGHTLY	RS - ROCK
FRAC. - FRACTURED, FRACTURES	TCR - TRICONE REFUSAL	RT - RECOMPACTED TRIAXIAL
FRAGS. - FRAGMENTS	w - MOISTURE CONTENT	CBR - CALIFORNIA BEARING RATIO
HI. - HIGHLY	V - VERY	

**EQUIPMENT USED ON SUBJECT PROJECT**

DRILL UNITS:	ADVANCING TOOLS:	HAMMER TYPE:
<input type="checkbox"/> CME-45C	<input type="checkbox"/> CLAY BITS	<input checked="" type="checkbox"/> AUTOMATIC <input type="checkbox"/> MANUAL
<input type="checkbox"/> CME-55	<input type="checkbox"/> 6" CONTINUOUS FLIGHT AUGER	
<input type="checkbox"/> CME-550	<input checked="" type="checkbox"/> 8" HOLLOW AUGERS	CORE SIZE:
<input type="checkbox"/> VANE SHEAR TEST	<input type="checkbox"/> HARD FACED FINGER BITS	<input type="checkbox"/> -B <input type="checkbox"/> -H
<input type="checkbox"/> PORTABLE HOIST	<input type="checkbox"/> TUNG-CARBIDE INSERTS	<input checked="" type="checkbox"/> -N Q
<input checked="" type="checkbox"/> MOBILE B-57	<input checked="" type="checkbox"/> CASING <input type="checkbox"/> W/ ADVANCER	HAND TOOLS:
	<input checked="" type="checkbox"/> TRICONE <input type="checkbox"/> STEEL TEETH	<input type="checkbox"/> POST HOLE DIGGER
	<input checked="" type="checkbox"/> TRICONE <input type="checkbox"/> TUNG-CARB.	<input type="checkbox"/> HAND AUGER
	<input checked="" type="checkbox"/> CORE BIT	<input type="checkbox"/> SOUNDING ROD
		<input type="checkbox"/> VANE SHEAR TEST





B-5731

2A

**NORTH CAROLINA DEPARTMENT OF TRANSPORTATION  
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# SUBSURFACE INVESTIGATION

## SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS (PAGE 2 OF 2)

ROCK DESCRIPTION		TERMS AND DEFINITIONS	
HARD ROCK IS NON-COASTAL PLAIN MATERIAL THAT WOULD YIELD SPT REFUSAL IF TESTED. AN INFERRED ROCK LINE INDICATES THE LEVEL AT WHICH NON-COASTAL PLAIN MATERIAL WOULD YIELD SPT REFUSAL. SPT REFUSAL IS PENETRATION BY A SPLIT SPOON SAMPLER EQUAL TO OR LESS THAN 0.1 FOOT PER 60 BLOWS IN NON-COASTAL PLAIN MATERIAL. THE TRANSITION BETWEEN SOIL AND ROCK IS OFTEN REPRESENTED BY A ZONE OF WEATHERED ROCK. ROCK MATERIALS ARE TYPICALLY DIVIDED AS FOLLOWS:			
WEATHERED ROCK (WR)		NON-COASTAL PLAIN MATERIAL THAT WOULD YIELD SPT N VALUES > 100 BLOWS PER FOOT IF TESTED.	
CRYSTALLINE ROCK (CR)		FINE TO COARSE GRAIN IGNEOUS AND METAMORPHIC ROCK THAT WOULD YIELD SPT REFUSAL IF TESTED. ROCK TYPE INCLUDES GRANITE, GNEISS, GABBRO, SCHIST, ETC.	
NON-CRYSTALLINE ROCK (NCR)		FINE TO COARSE GRAIN METAMORPHIC AND NON-COASTAL PLAIN SEDIMENTARY ROCK THAT WOULD YIELD SPT REFUSAL IF TESTED. ROCK TYPE INCLUDES PHYLLITE, SLATE, SANDSTONE, ETC.	
COASTAL PLAIN SEDIMENTARY ROCK (CP)		COASTAL PLAIN SEDIMENTS CEMENTED INTO ROCK, BUT MAY NOT YIELD SPT REFUSAL. ROCK TYPE INCLUDES LIMESTONE, SANDSTONE, CEMENTED SHELL BEDS, ETC.	
WEATHERING			
FRESH	ROCK FRESH, CRYSTALS BRIGHT, FEW JOINTS MAY SHOW SLIGHT STAINING. ROCK RINGS UNDER HAMMER IF CRYSTALLINE.		
VERY SLIGHT (V SL.)	ROCK GENERALLY FRESH, JOINTS STAINED, SOME JOINTS MAY SHOW THIN CLAY COATINGS IF OPEN. CRYSTALS ON A BROKEN SPECIMEN FACE SHINE BRIGHTLY. ROCK RINGS UNDER HAMMER BLOWS IF OF A CRYSTALLINE NATURE.		
SLIGHT (SL.)	ROCK GENERALLY FRESH, JOINTS STAINED AND DISCOLORATION EXTENDS INTO ROCK UP TO 1 INCH. OPEN JOINTS MAY CONTAIN CLAY. IN GRANITOID ROCKS SOME OCCASIONAL FELDSPAR CRYSTALS ARE DULL AND DISCOLORED. CRYSTALLINE ROCKS RING UNDER HAMMER BLOWS.		
MODERATE (MOD.)	SIGNIFICANT PORTIONS OF ROCK SHOW DISCOLORATION AND WEATHERING EFFECTS. IN GRANITOID ROCKS, MOST FELDSPARS ARE DULL AND DISCOLORED, SOME SHOW CLAY. ROCK HAS DULL SOUND UNDER HAMMER BLOWS AND SHOWS SIGNIFICANT LOSS OF STRENGTH AS COMPARED WITH FRESH ROCK.		
MODERATELY SEVERE (MOD. SEV.)	ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. IN GRANITOID ROCKS, ALL FELDSPARS DULL AND DISCOLORED AND A MAJORITY SHOW KAOLINIZATION. ROCK SHOWS SEVERE LOSS OF STRENGTH AND CAN BE EXCAVATED WITH A GEOLOGIST'S PICK. ROCK GIVES "CLUNK" SOUND WHEN STRUCK. <u>IF TESTED, WOULD YIELD SPT REFUSAL</u>		
SEVERE (SEV.)	ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. ROCK FABRIC CLEAR AND EVIDENT BUT REDUCED IN STRENGTH TO STRONG SOIL. IN GRANITOID ROCKS ALL FELDSPARS ARE KAOLINIZED TO SOME EXTENT. SOME FRAGMENTS OF STRONG ROCK USUALLY REMAIN. <u>IF TESTED, WOULD YIELD SPT N VALUES &gt; 100 BPF</u>		
VERY SEVERE (V SEV.)	ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. ROCK FABRIC ELEMENTS ARE DISCERNIBLE BUT MASS IS EFFECTIVELY REDUCED TO SOIL STATUS, WITH ONLY FRAGMENTS OF STRONG ROCK REMAINING. SAPROLITE IS AN EXAMPLE OF ROCK WEATHERED TO A DEGREE THAT ONLY MINOR VESTIGES OF ORIGINAL ROCK FABRIC REMAIN. <u>IF TESTED, WOULD YIELD SPT N VALUES &lt; 100 BPF</u>		
COMPLETE	ROCK REDUCED TO SOIL. ROCK FABRIC NOT DISCERNIBLE, OR DISCERNIBLE ONLY IN SMALL AND SCATTERED CONCENTRATIONS. QUARTZ MAY BE PRESENT AS DIKES OR STRINGERS. SAPROLITE IS ALSO AN EXAMPLE.		
ROCK HARDNESS			
VERY HARD	CANNOT BE SCRATCHED BY KNIFE OR SHARP PICK. BREAKING OF HAND SPECIMENS REQUIRES SEVERAL HARD BLOWS OF THE GEOLOGIST'S PICK.		
HARD	CAN BE SCRATCHED BY KNIFE OR PICK ONLY WITH DIFFICULTY. HARD HAMMER BLOWS REQUIRED TO DETACH HAND SPECIMEN.		
MODERATELY HARD	CAN BE SCRATCHED BY KNIFE OR PICK. GOUGES OR GROOVES TO 0.25 INCHES DEEP CAN BE EXCAVATED BY HARD BLOW OF A GEOLOGIST'S PICK. HAND SPECIMENS CAN BE DETACHED BY MODERATE BLOWS.		
MEDIUM HARD	CAN BE GROOVED OR GOUGED 0.05 INCHES DEEP BY FIRM PRESSURE OF KNIFE OR PICK POINT. CAN BE EXCAVATED IN SMALL CHIPS TO PEICES 1 INCH MAXIMUM SIZE BY HARD BLOWS OF THE POINT OF A GEOLOGIST'S PICK.		
SOFT	CAN BE GROVED OR GOUGED READILY BY KNIFE OR PICK. CAN BE EXCAVATED IN FRAGMENTS FROM CHIPS TO SEVERAL INCHES IN SIZE BY MODERATE BLOWS OF A PICK POINT. SMALL, THIN PIECES CAN BE BROKEN BY FINGER PRESSURE.		
VERY SOFT	CAN BE CARVED WITH KNIFE. CAN BE EXCAVATED READILY WITH POINT OF PICK. PIECES 1 INCH OR MORE IN THICKNESS CAN BE BROKEN BY FINGER PRESSURE. CAN BE SCRATCHED READILY BY FINGERNAIL.		
FRACTURE SPACING		BEDDING	
TERM	SPACING	TERM	THICKNESS
VERY WIDE	MORE THAN 10 FEET	VERY THICKLY BEDDED	4 FEET
WIDE	3 TO 10 FEET	THICKLY BEDDED	1.5 - 4 FEET
MODERATELY CLOSE	1 TO 3 FEET	THINLY BEDDED	0.16 - 1.5 FEET
CLOSE	0.16 TO 1 FOOT	VERY THINLY BEDDED	0.03 - 0.16 FEET
VERY CLOSE	LESS THAN 0.16 FEET	THICKLY LAMINATED	0.008 - 0.03 FEET
		THINLY LAMINATED	< 0.008 FEET
INDURATION			
FOR SEDIMENTARY ROCKS, INDURATION IS THE HARDENING OF MATERIAL BY CEMENTING, HEAT, PRESSURE, ETC.			
FRIABLE	RUBBING WITH FINGER FREES NUMEROUS GRAINS; GENTLE BLOW BY HAMMER DISINTEGRATES SAMPLE.		
MODERATELY INDURATED	GRAINS CAN BE SEPARATED FROM SAMPLE WITH STEEL PROBE; BREAKS EASILY WHEN HIT WITH HAMMER.		
INDURATED	GRAINS ARE DIFFICULT TO SEPARATE WITH STEEL PROBE; DIFFICULT TO BREAK WITH HAMMER.		
EXTREMELY INDURATED	SHARP HAMMER BLOWS REQUIRED TO BREAK SAMPLE; SAMPLE BREAKS ACROSS GRAINS.		
		<b>BENCH MARK: BL-4:</b>	
		N: 897974.8 E: 1717792.3	
		STA. 15+38.66 OFFSET: 14.8' RT, -L- ELEVATION: 783.79 FEET	
<b>NOTES:</b>			
FIAD - FILLED IMMEDIATELY AFTER DRILLING			

DATE: 8-15-14

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# **SUBSURFACE INVESTIGATION**

## **SUPPLEMENTAL LEGEND, GEOLOGICAL STRENGTH INDEX (GSI) TABLES FROM AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS (PAGE 1 OF 2)**

AASHTO LRFD Figure 10.4.6.4-1 — Determination of GSI for Jointed Rock Mass (Marinos and Hoek, 2000)

### GEOLOGICAL STRENGTH INDEX (GSI) FOR JOINTED ROCKS (Hoek and Marinos, 2000)

From the lithology, structure and surface conditions of the discontinuities, estimate the average value of GSI. Do not try to be too precise. Quoting a range from 33 to 37 is more realistic than stating that GSI = 35. Note that the table does not apply to structurally controlled failures. Where weak planar structural planes are present in an unfavorable orientation with respect to the excavation face, these will dominate the rock mass behaviour. The shear strength of surfaces in rocks that are prone to deterioration as a result of changes in moisture content will be reduced if water is present. When working with rocks in the fair to very poor categories, a shift to the right may be made for wet conditions. Water pressure is dealt with by effective stress analysis.

SURFACE CONDITIONS

**VERY GOOD**  
Very rough, fresh unweathered surfaces

**GOOD**  
Rough, slightly weathered, iron stained surfaces

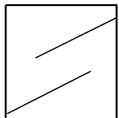
**FAIR**  
Smooth, moderately weathered and altered surfaces

**POOR**  
Slickensided, highly weathered surfaces with compact coatings or fillings or angular fragments

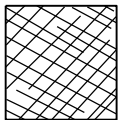
**VERY POOR**  
Slickensided, highly weathered surfaces with soft clay coatings or fillings

## STRUCTURE

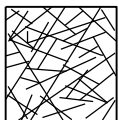
DECREASING SURFACE QUALITY →



INTACT OR MASSIVE - intact rock specimens or massive in situ rock with few widely spaced discontinuities



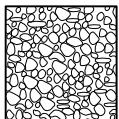
BLOCKY - well interlocked undisturbed rock mass consisting of cubical blocks formed by three intersecting discontinuity sets



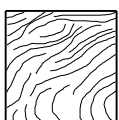
VERY BLOCKY - interlocked, partially disturbed mass with multi-faceted angular blocks formed by 4 or more joint sets



BLOCKY/DISTURBED/SEAMY - folded with angular blocks formed by many intersecting discontinuity sets. Persistence of bedding planes or schistosity



DISINTEGRATED - poorly interlocked, heavily broken rock mass with mixture of angular and rounded rock pieces



LAMINATED/SHEARED - Lack of blockiness due to close spacing of weak schistosity or shear planes

DECREASING INTERLOCKING OF ROCK PIECES ↓

90

80

70

60

50

40

30

20

10

N/A

N/A

N/A

N/A

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# **SUBSURFACE INVESTIGATION**

## **SUPPLEMENTAL LEGEND, GEOLOGICAL STRENGTH INDEX (GSI) TABLES FROM AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS (PAGE 2 OF 2)**

AASHTO LRFD Figure 10.4.6.4-2 — Determination of GSI for Tectonically Deformed Heterogeneous Rock Masses (Marinos and Hoek, 2000)

GSI FOR HETEROGENEOUS ROCK MASSES SUCH AS FLYSCH (Marinos, P and Hoek E., 2000)

From a description of the lithology, structure and surface conditions (particularly of the bedding planes), choose a box in the chart. Locate the position in the box that corresponds to the condition of the discontinuities and estimate the average value of GSI from the contours. Do not attempt to be too precise. Quoting a range from 33 to 37 is more realistic than giving GSI = 35. Note that the Hoek-Brown criterion does not apply to structurally controlled failures. Where unfavourably oriented continuous weak planar discontinuities are present, these will dominate the behaviour of the rock mass. The strength of some rock masses is reduced by the presence of groundwater and this can be allowed for by a slight shift to the right in the columns for fair, poor and very poor conditions. Water pressure does not change the value of GSI and it is dealt with by using effective stress analysis.

SURFACE CONDITIONS OF DISCONTINUITIES  
(Predominantly bedding planes)

VERY GOOD - Very Rough, fresh unweathered surfaces

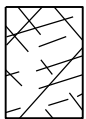
GOOD - Rough, slightly weathered surfaces

FAIR - Smooth, moderately weathered and altered surfaces

POOR - Very smooth, occasionally slickensided surfaces with compact coatings or fillings with angular fragments

VERY POOR - Very smooth, slickensided or highly weathered surfaces with soft clay coatings or fillings

### COMPOSITION AND STRUCTURE



**A.** Thick bedded, very blocky sandstone. The effect of pelitic coatings on the bedding planes is minimized by the confinement of the rock mass. In shallow tunnels or slopes these bedding planes may cause structurally controlled instability.



**B.** Sandstone with thin inter-layers of siltstone



**C.** Sandstone and siltstone in similar amounts



**D.** Siltstone or silty shale with sandstone layers



**E.** Weak siltstone or clayey shale with sandstone layers

**C, D, E, and G** - may be more or less folded than illustrated but this does not change the strength. Tectonic deformation, faulting and loss of continuity moves these categories to **F** and **H**.



**F.** Tectonically deformed, intensively folded/faulted, sheared clayey shale or siltstone with broken and deformed sandstone layers forming an almost chaotic structure



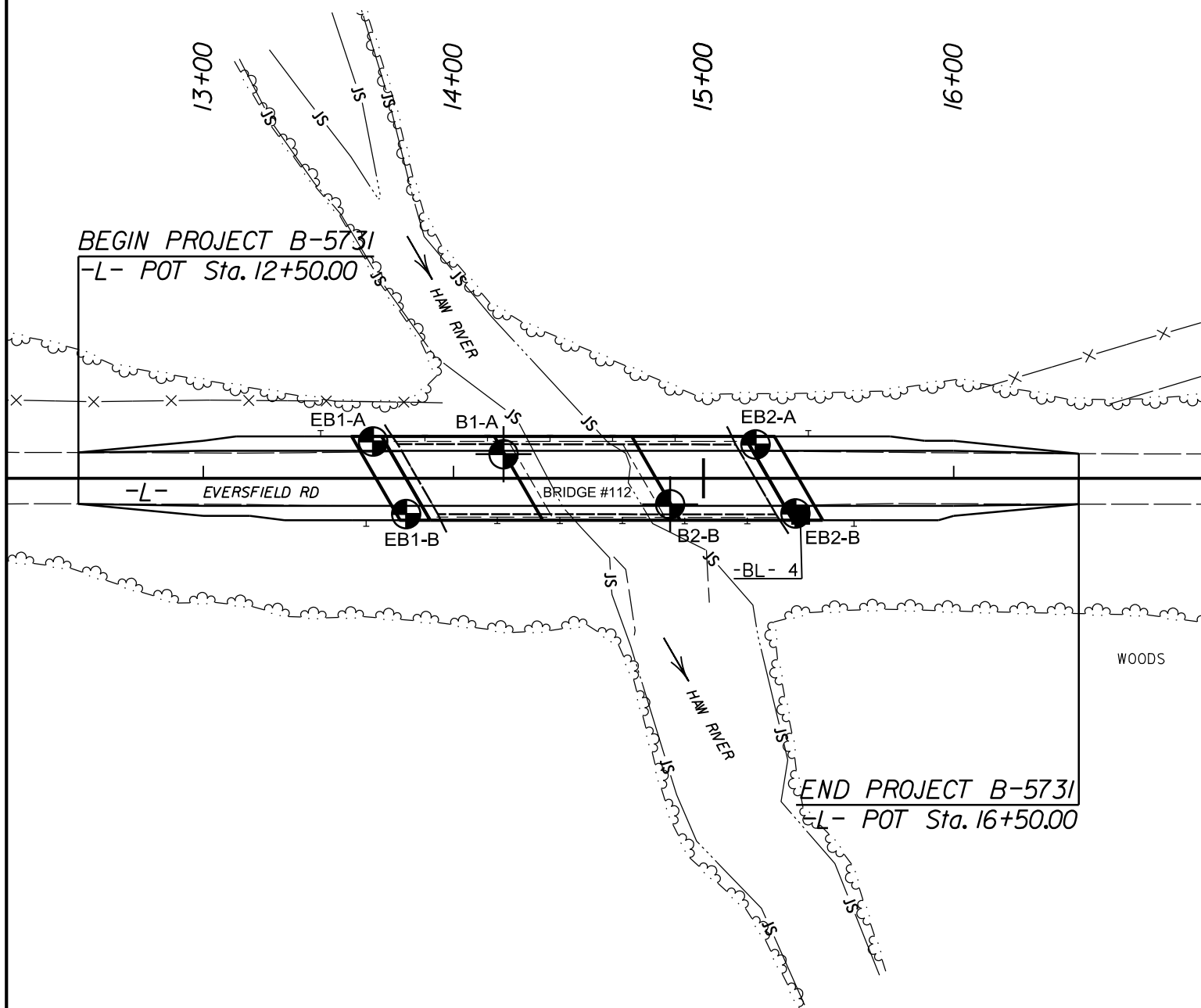
**G.** Undisturbed silty or clayey shale with or without a few very thin sandstone layers



**H.** Tectonically deformed silty or clayey shale forming a chaotic structure with pockets of clay. Thin layers of sandstone are transformed into small rock pieces.

➡ Means deformation after tectonic disturbance

NAD 83/NSRS 2007



## NOTES:

- PLANS ADOPTED FROM ELECTRONIC SURVEY FILES RECEIVED FROM MOTT MACDONALD DATED DECEMBER, 2016.
- BRIDGE SKEW: 60°



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## BORING LOCATION PLAN

BRIDGE NO. 112 ON SR 2109  
(EVERTSFIELD RD.) OVER HAW RIVER  
GUILFORD COUNTY, NORTH CAROLINA  
WBS NO.: 45687.1.1 | TIP NO.: B-5731  
FALCON PROJECT NO.: G16037.04

# GEOTECHNICAL BORING REPORT

## BORE LOG

SHEET 4

WBS 45687.1.1			TIP B-5731			COUNTY GUILFORD			GEOLOGIST Goodnight, D.						
SITE DESCRIPTION BRIDGE NO. 112 ON SR 2109 (EVERSFIELD RD.) OVER HAW RIVER									GROUND WTR (ft)						
BORING NO. EB1-A			STATION 13+68			OFFSET 15 ft LT			ALIGNMENT -L-			0 HR. N/A			
COLLAR ELEV. 788.1 ft			TOTAL DEPTH 38.9 ft			NORTHING 897,812			EASTING 1,717,733			24 HR. 13.4			
DRILL RIG/HAMMER EFF./DATE TRI8016 MOBILE B-57 90% 02/22/2016						DRILL METHOD H.S. Augers			HAMMER TYPE Automatic						
DRILLER Estep, J. E.			START DATE 01/18/17			COMP. DATE 01/25/17			SURFACE WATER DEPTH N/A						
ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION	DEPTH (ft)
			0.5ft	0.5ft	0.5ft	0	25	50	75	100					
790															
	787.1	1.0	2	1	2	3								TOPSOIL	0.0
785	784.6	3.5	1	2	2	4								ROADWAY EMBANKMENT	
	782.1	6.0	1	1	2	3								TAN, SILTY SAND (A-2-4)	
780	779.6	8.5	1	1	1	2									
	774.6	13.5	1	WOH	2	2								ALLUVIAL	10.5
775														GRAY, SANDY SILTY CLAY (A-7), W/	
	769.6	18.5	1	1	1	2								TRACE ORGANICS (WOOD FRAGMENTS AND STEMS)	
770	764.6	23.5	1	1	2	3								ALLUVIAL	17.0
	759.6	28.5	3	2	3	5								GRAY, SILTY F. TO CSE. SAND (A-2-4), W/	
765														TRACE ORGANICS	
	754.6	33.5	10	9	10	19									
760	749.6	38.5												ALLUVIAL	27.0
														TAN, F. TO CSE. SAND (A-1-b)	
755															
														RESIDUAL	32.8
750														GRAY, SILTY F. TO CSE. SAND (A-2-4)	
														SAPROLITIC	36.3
														WEATHERED ROCK	
														TAN, GRANITE	38.9
														Boring Terminated at Elevation 749.2 ft IN	
														WR: GRANITE	






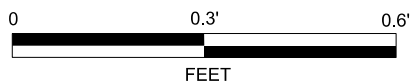


# GEOTECHNICAL BORING REPORT

## CORE LOG

SHEET 7

WBS 45687.1.1				TIP B-5731		COUNTY GUILFORD				GEOLOGIST Goodnight, D.			
SITE DESCRIPTION BRIDGE NO. 112 ON SR 2109 (EVERSFIELD RD.) OVER HAW RIVER										GROUND WTR (ft)			
BORING NO. B1-A				STATION 14+20		OFFSET 10 ft LT				ALIGNMENT -L-		0 HR. N/A	
COLLAR ELEV. 774.5 ft				TOTAL DEPTH 23.3 ft		NORTHING 897,862				EASTING 1,717,747		24 HR. 1.5	
DRILL RIG/HAMMER EFF./DATE TRI8016 MOBILE B-57 90% 02/22/2016						DRILL METHOD SPT Core Boring				HAMMER TYPE Automatic			
DRILLER Estep, J. E.				START DATE 01/24/17		COMP. DATE 01/24/17				SURFACE WATER DEPTH N/A			
CORE SIZE NQ				TOTAL RUN 10.0 ft									
ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN		SAMP. NO.	STRATA		L O G	DESCRIPTION AND REMARKS	DEPTH (ft)	
					REC. (ft) %	RQD (ft) %		REC. (ft) %	RQD (ft) %				
761.2													
760	761.2	13.3	5.0	2:47/1.0 2:12/1.0 3:01/1.0 2:19/1.0 2:50/1.0	(4.8) 96%	(3.9) 78%		(10.0) 100%	(8.9) 89%		761.2	13.3	
	756.2	18.3											
755			5.0	2:47/1.0 2:59/1.0 3:13/1.0 4:17/1.0 4:13/1.0	(5.0) 100%	(5.0) 100%							
	751.2	23.3										751.2	23.3
												Boring Terminated at Elevation 751.2 ft IN CR: GRANITE	



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#### ROCK CORE PHOTOS


BRIDGE NO. 112 ON SR 2109  
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GUILFORD COUNTY, NORTH CAROLINA  
WBS NO.: 45687.1.1 | TIP NO.: B-5731  
FALCON PROJECT NO.: G16037.04



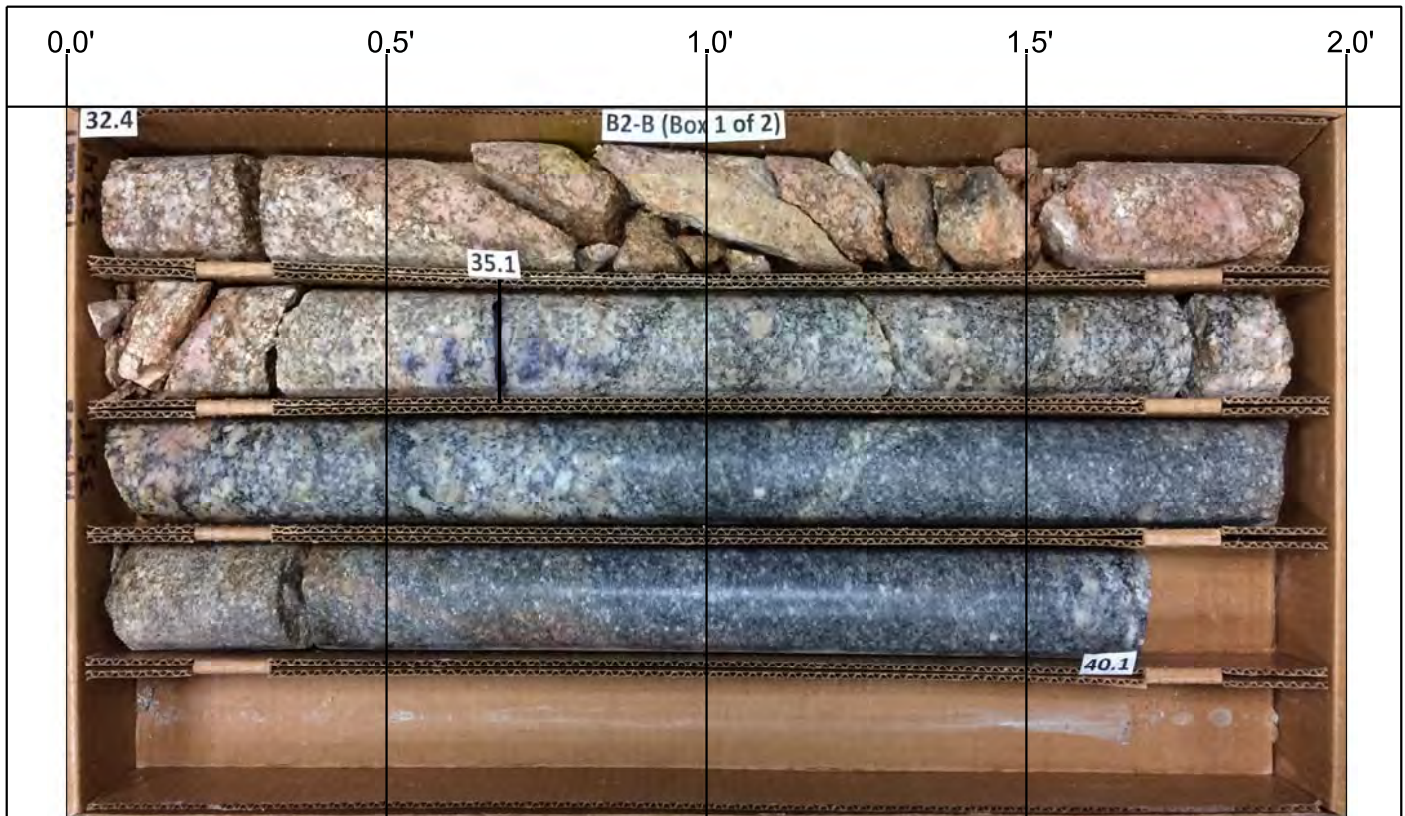
# GEOTECHNICAL BORING REPORT

## CORE LOG

SHEET 10

<b>WBS</b> 45687.1.1				<b>TIP</b> B-5731		<b>COUNTY</b> GUILFORD				<b>GEOLOGIST</b> Goodnight, D.			
<b>SITE DESCRIPTION</b> BRIDGE NO. 112 ON SR 2109 (EVERSFIELD RD.) OVER HAW RIVER										<b>GROUND WTR (ft)</b>			
<b>BORING NO.</b> B2-B				<b>STATION</b> 14+87		<b>OFFSET</b> 10 ft RT		<b>ALIGNMENT</b> -L-		<b>0 HR.</b> N/A			
<b>COLLAR ELEV.</b> 774.4 ft				<b>TOTAL DEPTH</b> 45.1 ft		<b>NORTHING</b> 897,924		<b>EASTING</b> 1,717,779		<b>24 HR.</b> 1.7			
<b>DRILL RIG/HAMMER EFF./DATE</b> TRI8016 MOBILE B-57 90% 02/22/2016						<b>DRILL METHOD</b> SPT Core Boring				<b>HAMMER TYPE</b> Automatic			
<b>DRILLER</b> Estep, J. E.				<b>START DATE</b> 01/19/17		<b>COMP. DATE</b> 01/20/17		<b>SURFACE WATER DEPTH</b> N/A					
<b>CORE SIZE</b> NQ				<b>TOTAL RUN</b> 12.7 ft									
ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN		SAMP. NO.	STRATA		L O G	DESCRIPTION AND REMARKS	DEPTH (ft)	
					REC. (ft) %	RQD (ft) %		REC. (ft) %	RQD (ft) %				
742											Begin Coring @ 32.4 ft		
740	742.0	32.4	2.7	1:28/0.7	(2.6)	(1.0)		(2.3)	(0.7)		742.0	32.4	
	739.3	35.1		2:19/1.0 3:46/1.0	96%	37%	96%	29%	739.6		34.8		
735			5.0	3:01/1.0 4:55/1.0 6:24/1.0 3:42/1.0 7:23/1.0	(5.0)	(4.8)	100%	100%	88%		738.0	36.4	
	734.3	40.1											
			5.0	4:51/1.0 6:36/1.0 6:29/1.0 6:15/1.0 7:23/1.0	(5.0)	(5.0)	100%	100%					
730	729.3	45.1									729.3	45.1	
<p>MODERATELY SEVERE WEATHERING, MODERATELY HARD, PINK AND TAN, GRANITE WITH V. CLOSE TO CLOSE FRACTURE SPACING  2 FRACTURES AT 60-70 DEGREES  2 FRACTURES AT 30-40 DEGREES  2 FRACTURES AT 5-10 DEGREES  WITH IRON STAINING  GSI = 45</p> <p>MODERATE WEATHERING, HARD, TAN TO GRAY, GRANITE, WITH CLOSE TO MODERATELY CLOSE FRACTURE SPACING  2 FRACTURES AT 5-10 DEGREES  GSI = 55</p> <p>V. SLIGHT WEATHERING TO FRESH, HARD, TAN TO GRAY, GRANITE, WITH CLOSE TO MODERATELY CLOSE FRACTURE SPACING  4 FRACTURES AT 5-10 DEGREES  1 FRACTURE AT 45 DEGREES  GSI = 65</p> <p style="text-align: center;">Boring Terminated at Elevation 729.3 ft IN CR: GRANITE</p>													

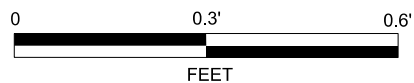




BORING B2-B, BOX 1 OF 2, 32.4 FEET TO 40.1 FEET.



BORING B2-B, BOX 2 OF 2, 40.1 FEET TO 45.1 FEET.



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## ROCK CORE PHOTOS

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[illegible]

## SHEET 13

NC DOT BORE SINGLE B5731 GINT.GPJ NC\_DOT.GDT 7/27/17





LOOKING SOUTH TOWARD END BENT ONE FROM END BENT TWO ALONG -L-



VIEW OF BRIDGE FROM WEST OF END BENT ONE LOOKING NORTHEAST



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SITE PHOTOGRAPHS

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